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Novel Collection and Analysis Techniques for Trace Narcotics Detection

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Microanalytical Systems

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Abstract

This report discusses work performed in several areas applying novel approaches to the collection and analysis of trace drug material. The following key results have been demonstrated: (1) extraction of residual methamphetamine, cocaine, and heroin from sea water using solid phase microextraction, (2) the separation and detection of methamphetamine in methanol solution using a micro-gas chromatograph developed at Sandia coupled to a flame ionization detector, and (3) collection of methamphetamine vapor in a miniaturized (1.5 inch diameter) version of Sandia's screen preconcentrator with near 50% efficiency. Further work in all of these application areas could prove useful to a variety of potential customers with interests in drug detection.

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Contents

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Acronyms and Abbreviations

b.p.	boiling point
cc	cubic centimeter
cm	centimeters
FID	flame ionization detector
GC	gas chromatograph
GC/MS	gas chromatograph/mass spectrometer
IMS	ion mobility spectrometry
LDRD	laboratory directed research and developed
LSD	D-lysergic acid diethylamide
min	minute
mL	milliliter
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
SEM	scanning electron microscopy
SPME	solid phase microextraction
SSP	Sandia screen preconcentrator
THC	tetrahydrocannabinol
µl	microliter
µm	micrometer
vap.	vapor pressure

I. Introduction

This report describes research performed in fiscal year 2001 for LDRD project 34475, originally entitled "Miniaturized Sensor Technologies for Drug Detection." As the work on this project progressed, the scope was expanded to include work in one significant new area of drug detection, the extraction of trace drug material from seawater. Since this broadens the project beyond the area of miniaturized sensors and preconcentrators, the title of this report has been altered to reflect this change.

The work described herein occurred in three main areas, each involving a different department at Sandia. These are listed here in the order in which they are presented below. The first research area presented is the above-mentioned extraction of explosives from seawater. This work, carried out by researchers in Department 2552, used a traditional gas chromatograph/mass spectrometer system to investigate separation and analysis of cocaine, heroin, and tetrahydrocannabinol (THC) in seawater using solid phase micro-extraction. The second research area, involving personnel in Department 1764, utilized components from Sandia's μChemLab™. Specifically, the separation of trace amounts of various drugs was investigated using a micro-GC and a flame ionization detector. Finally, work performed in Department 5848 focused on the preconcentration of drug vapors, using a miniaturized version of the Sandia screen preconcentrator that was developed for use in an explosives detecting personnel portal.

In addition to discussion of these main research areas, this report contains some additional information on the general problem of illegal drugs in the United States. Some background information is provided in the remainder of this introductory section, and related reports and information sources are listed in Appendix A. This appendix should be useful to any readers of this report seeking a wider background in this topic.

I.1 Background – Drug Trafficking and Drug Use in the United States

While most Americans are aware that illegal drug use in the United States is becoming more prevalent in our younger citizens, many do not realize the profound impact that this drug epidemic has on the country as a whole. According to a *Substance Abuse and Mental Health Services Administration* survey, employees who test positive for drug use submit more than twice as many workers compensation claims as non-drug users. In addition, drug-related violence poses a grave and much more direct threat to the United States. Seventy-five percent of violent criminals tested positive for drugs. One-quarter to one-half of all incidents of domestic violence are drug-related. Over 3.2% of pregnant women (≈80,000 per year) use illegal drugs regularly. These statistics, while alarming, show only small portions of the effect drugs have on our society.

All terrorist organizations need to raise funds to sustain their violent activities and often resort to illegal means to finance their activities. Drug trafficking comes at the top of this list of illegal money-raising activities. In recent years, it has become increasingly evident that terrorism and drug trafficking are intertwined. The terms "narco-terrorism" and "narco-terrorists" describe this interface between terrorist organizations and narcotics smugglers. The UN Convention Against Illicit Traffic In Narcotic Drugs and Psychotropic Substances (1988)

recognizes the links between illicit drug traffic and other organized criminal activities which undermine the stability, security, and legitimacy of sovereign states. Narcotic drugs such as morphine base and heroin from Iran, Pakistan, and Afghanistan are smuggled across Turkey's eastern borders.

Since the early 1960s, there has been an alarming increase in drug use in the United States. In 1962, four million Americans had tried illegal drugs. By 1999, that number had risen to a staggering 87.7 million according to the *1999 Household Survey on Drug Abuse.* Some of the drugs currently being used are considerably more pure than they have been in the past.

II Extraction of Drug Residue from Seawater

Drug interdiction efforts have relied largely on tips, surveillance of known drug routes, and random searches of vehicles, ships, or personnel. The ability to focus search efforts on more likely targets would increase the effectiveness of the drug interdiction program. One of the most difficult, but potentially most valuable applications, is the ability to detect narcotic substances that have been released during transport by boat in the marine environment. A primary entry route for drugs into the United States is through harbor channels such as Miami, New York City, and the Gulf of Mexico, with shipments arriving from Asia, South America, and Mexico. Ships that transport large quantities of drugs often release trace amounts of these compounds through bilge discharge or through their waste system. Development of an underwater sampling and chemical analysis system that could rapidly detect traces of drugs would allow authorities to focus on the ships that are most likely to contain drugs and would also provide probable cause to search those vessels.

II.1 Technical Approach

The focus of this component of the study is to determine whether drug residue can be detected in seawater. The drugs investigated were cocaine, heroin, and tetrahydrocannabinol (THC), one of the primary constituents of marijuana. Solid phase microextraction (SPME) was used to extract the drugs from the seawater and preconcentrate the sample for introduction into a gas chromatograph/mass spectrometer (GC/MS). The GC/MS was used as a detector because it could provide quantitative results and positive confirmation that the drugs were extracted. Other, more fieldable sensors such as ion mobility spectrometers could be employed, but would not provide the quantitation desired for these tests.

II.2 Experimental Design

A 100 ppb drug standard was prepared using THC, cocaine, and heroin supplied by Aldrich Chemicals. The standards were prepared in Instant Ocean (2.5% w/w) to simulate ocean salinity. A 100μm polydimethylsiloxane SPME fiber was placed into the solution for 30 minutes without any agitation. The SPME fiber was then analyzed on a Finnegan GCQ gas chromatograph/mass spectrometer using the following parameters:

Gas Chromatograph

- Injector 250°C
- Helium carrier gas flow rate 40 cm/second linear velocity
- Constant flow mode

- Splitless mode (≈.20 splitless and 0.75 split)
- Initial oven temperature 50°C
- Hold 2 minutes
- Ramp 15°C/minute to 300°C
- Hold for 15 minutes

Mass Spectrometer

- Filament delay 3 minutes
- Quantitation was done using extracted ion mode, masses 182, 327, and 299 for cocaine, heroin, and THC, respectively.

II.3 Results

Multiple analyses were performed under different conditions and using different SPME fibers. It was found that a polydimethylsiloxane/divinyl benzene SPME fiber was not effective in extracting drugs from seawater, even though references to its use were found. The 100µm polydimethylsiloxane SPME fiber was found to be optimal. Likewise, when using fresh water instead of seawater, the only drug that was extracted was the THC; the cocaine and heroin were not removed. The chromatogram in Figure 1 shows a typical chromatogram obtained from the extraction of seawater. The extraction of heroin is not as efficient as that of THC or cocaine.

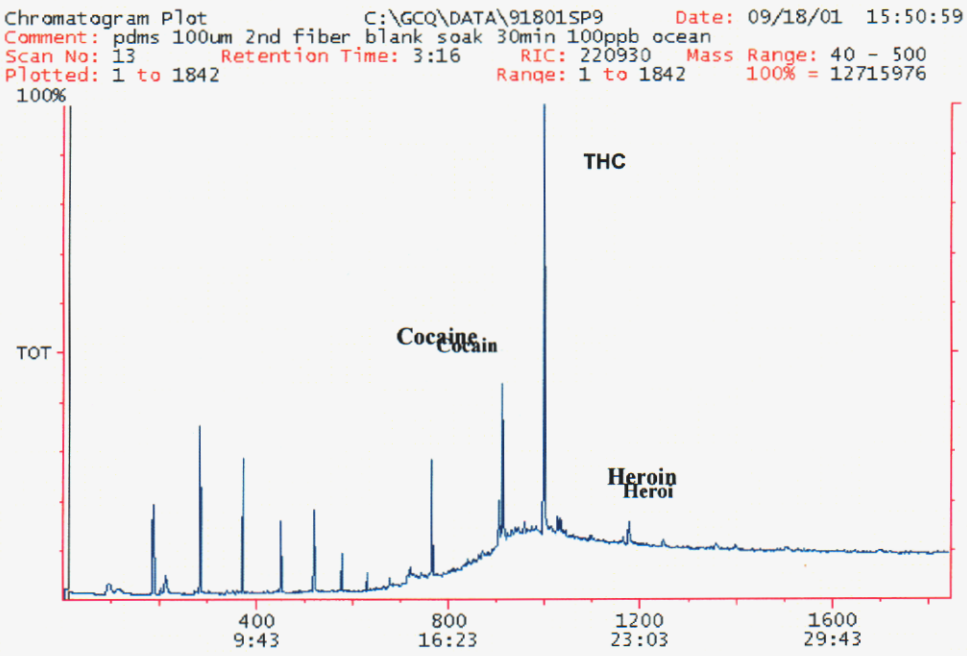

Figure 1. Chromatogram of cocaine, heroin, and THC extracted from artificial seawater

Figures 2 through 4 show the mass spectra obtained from the extracted drugs.

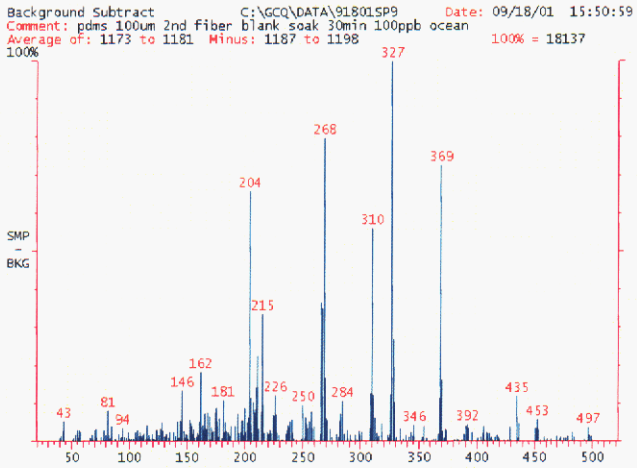

Figure 2. Spectrum of Heroin

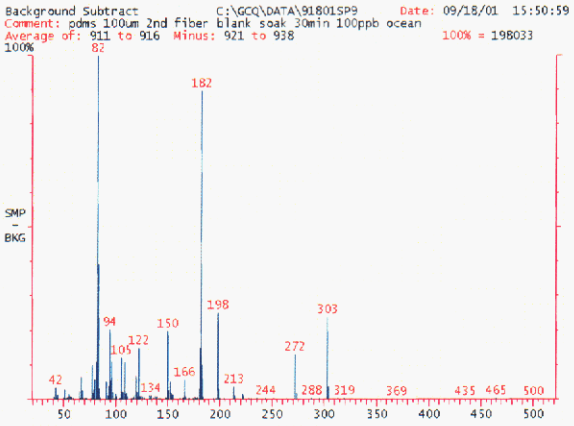

Figure 3. Spectrum of Cocaine

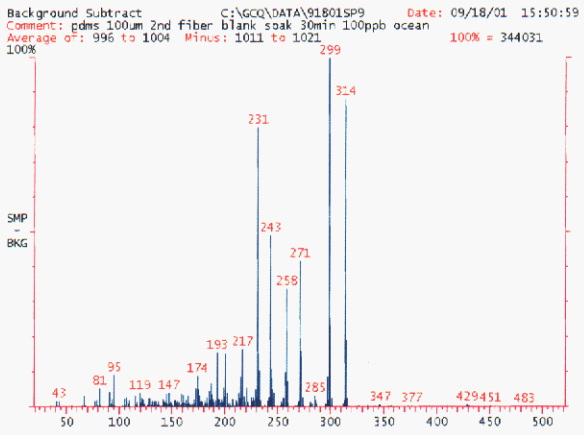

Figure 4. Spectrum of THC

II.4 Conclusion

THC, cocaine, and heroin samples can be collected, analyzed, and positively identified in thirty minutes at 100 ppb in 2.5% salt water. Using static sampling, we estimate a minimum detection limit of approximately 2 ppb THC, 4 ppb cocaine, and 20 ppb heroin. Using EPA methodology, the detection limits, based on 8 samples, are 35 ppb, 61 ppb, and 89 ppb for THC, cocaine, and heroin, respectively, with 99% confidence. Static sampling, however, typically provides poor extraction efficiency because of diffusion limitations. Agitation of the SPME fiber and/or extraction from flowing systems (e.g., pumped water) typically provides at least a 10x increase in sensitivity (based on our experience performing explosives analysis in seawater.)

III. Separation and Detection of Trace Drug Samples Using a Micro-Gas Chromatograph and Flame Ionization Detector

III.1 Background

Since 1996, a handheld instrument capable of gas phase chemical analysis has been under development at Sandia. The instrument has been dubbed μChemLab™ because it utilizes microfabricated components to provide a faster response, smaller size, and lower power requirements than existing instruments. The μChemLab™ is similar to commercial benchtop chemical analysis systems in that it uses three basic functions in a cascaded approach for analysis: sample introduction, separation, and detection. In the case of the μChemLab™, these functions are performed by a sample collector/preconcentrator (PC), a gas chromatographic separator (microGC column), and a chemically selective surface acoustic wave (SAW) detector array.

The PC uses a thermally isolated silicon nitride membrane that provides rapid heating at low power (10ms to 200°C with ~100mW of power). Different high surface area coatings can be deposited on a PC to collect and concentrate a wide variety of compounds from the gas phase. MicroGC columns are made by cutting spiral channels in silicon using a deep reactive ion etching process and anodically bonding a Pyrex™ lid over the top. Column lengths up to one meter are possible on a one-centimeter-square die, and different stationary phases are coated inside the column to provide separation efficiency. The SAW detector consists of a four-sensor platform where one sensor acts as a reference whereas the other three have chemically selective coatings. Like the other components, polymer coatings are used to vary the selectivity and sensitivity of each SAW detector for the desired application.

Initially the μChemLab™ was designed to test for chemical warfare (CW) agents and a battery-operated, fully autonomous unit has been assembled. The capabilities of each of its components have expanded, leading in part to one of the goals of this LDRD: to evaluate μChemLab™ components in the application of drug detection. Because microGC columns are the most abundant and the simplest to evaluate, and because separation is a key function for many instrument concepts that intend to detect drugs in a field setting, microGCs were evaluated first. Results of these and other tests are presented.

III.1.1 Sample Information

Several drug compounds were obtained for investigation using μChemLab components. The physical properties and other information relevant to GC analysis are shown in Table 1. The last

column contains information obtained from the data sheets included with the compounds by the supplier (Sigma, St. Louis, MO). The supplier performs a purity check on the compounds before shipment, and uses the same conditions for each compound. The temperature at which each compound elutes is useful for determining initial conditions for our testing. The vapor pressures listed were obtained from references [1] and [2], which include estimated values.

Table 1: Physical and Analytical Information

Drug	Concen-tration. on hand (µg/µL)	Chemical Abstracts Service # (CAS #)	Boiling point (b.p.) or Vapor pressure (vap)	Highest mass observed in Sigma data sheet	GC conditions (Sigma) elution time (temp.)
d-amphetamine sulfate	1.42	51-63-8	Vap 214 ppm	134	db-1, 0.2 mm, 15m, 0.2 film, 50 (2), 15C/min to 300. elutes ~6 min. (110°C)
d-amphetamine-d3 sulfate	0.131	119039-59-7	Not available (N/A)	137	5.9 min. (108°C)
(+) methamphetamine HCl	1.01	51-57-0	N/A	148	~6.9 min. (123°C)
heroin HCl	0.109	1502-95-0	b.p. 273 vap 1 ppt 4.93E-013 mm Hg estimated [2]	369	~16.5 min. (267°C)
morphine –d3 HCl	0.114	118357-24-7	vap 1.69E-009 mm Hg estimated [2]	288	~16.1 min. [TMS derivative] (261°C)
Δ8 THC	1.02	5957-75-5	61 ppt or 4.63E-008 mm Hg estimated [2]	314	~15.2 min. (248°C)
Δ9 THC	1.02	81586-39-2	N/A	314	~16.0 min. (260°C)
Δ9 THC d3	0.102	81586-39-2	N/A	317	~15.9 min. (258°C)
Lysergic acid diethylamide	0.026	50-37-3	1.2 ppt 9.03E-010 mm Hg estimated [2]	323	~12.1 min. (201°C)
Cocaine	1.13	53-21-4	vap 0.25 ppb	303	~14.4 min. (236°C)
Cocaine d3	0.102	53-21-4	vap 0.25 ppb	303	~14.2 min. (233°C)
Codeine-d3 HCl	0.114	70420-71-2	b.p. 250 4.15E-009 mm Hg estimated [2]	302	~8.5 min. (147°C)

Several of the drugs are indicated by a d3, indicating that they are deuterated (i.e., one or more hydrogens are replaced by deuterium). This is a common technique in analytical chemistry. These compounds are used in commercial analyses as an internal standard. The deuteration allows them to be differentiated from the nascent compound by the mass spectrometer detector.

III-2 Previous Methods of Analysis

In addition to the supplier's information in Table 1, elution information can be obtained from GC column supplier catalogs, as shown in the example in Figure 5 [3].

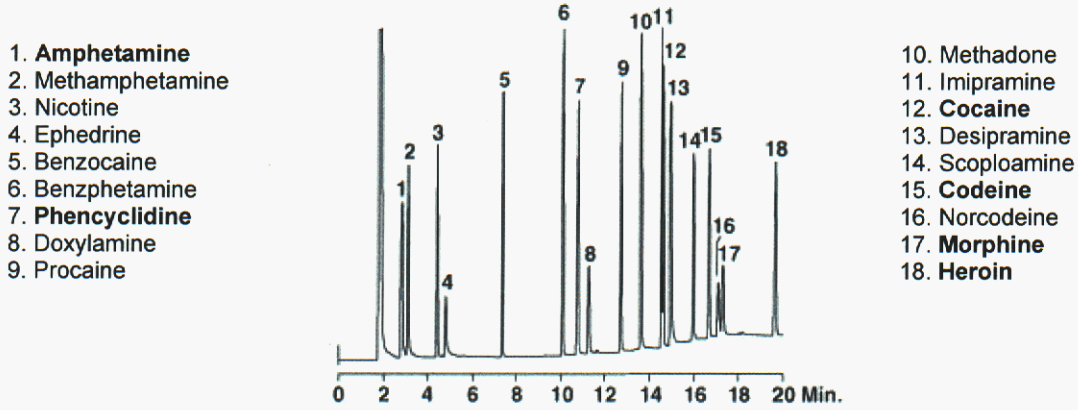

Figure 5. Alltech chromatogram illustrating separation of common drugs

This example uses the following conditions:

- AT™-20
- 30m x 0.25mm x 0.25um film thickness (20% phenylmethyl silicon phase)
- Column temperature 150°C (2 min hold) to 290°C (5 min hold) at 10°C/min
- Injector temperature 250°
- Injector split ratio 100:1
- Split flow 65mL/min
- Detector temperature 275°C
- Detector FID
- Carrier gas helium
- Linear velocity flow rate 0.65 mL/min
- Sample size injection volume – 2 µL (250 µg/mL)
- Sample solvent methanol

III-3 Experimental Details

The microGC columns utilized here have been described elsewhere [4]. They are fabricated in silicon and coated with different liquid stationary phases. These phases enable the separation of compounds. Two types of columns were used in this work: an 86 cm long x 400 µm x 100 µm or a 150 cm long x 150 µm x 52 µm column. They are attached via capillary connectors inside a commercial gas chromatograph as shown in Figure 6. The photograph in Figure 6 shows a Scanning Electron Micrograph (SEM) image of a spiral column. The test fixture allows the

plumbing connections to the GC. The detector is a flame ionization detector. For those tests using a solid phase microextraction fiber (SPME), the same columns and conditions were used. The SPME fiber was a 100μm-coated polydimethylsiloxane (PDMS) fiber and was immersed in the sample solution for five minutes.

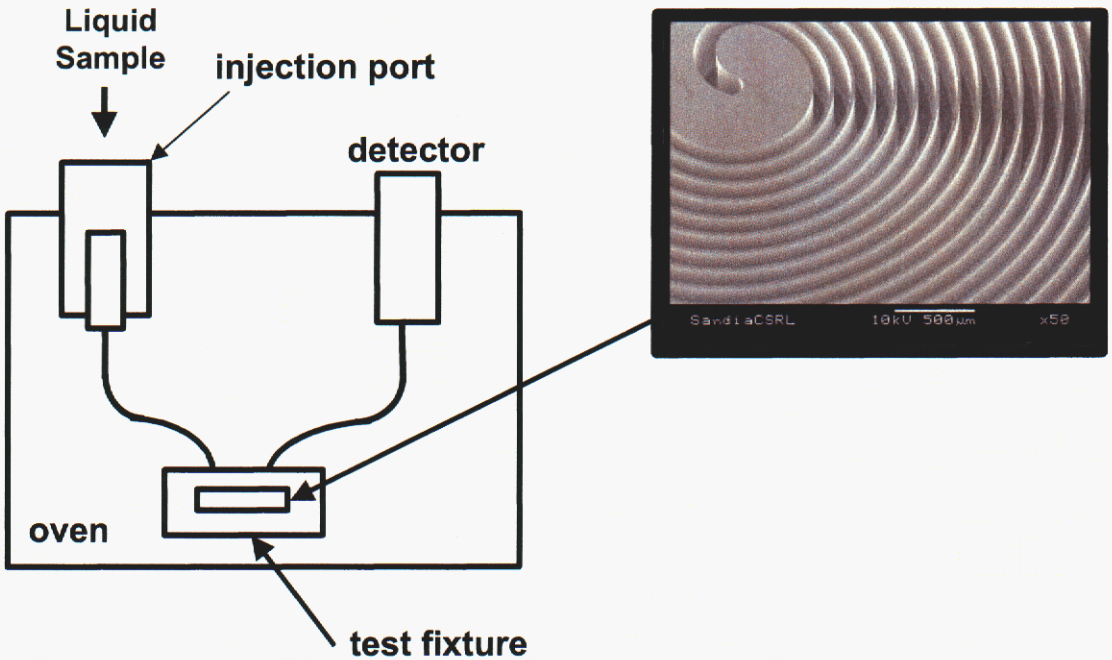

Figure 6. Schematic of test setup for microGC columns

III-4 Results and Discussion

III-4.1 MicroGC Tests

Several microGCs were tested with various drug solutions. A common problem encountered was a lack of separation power of the current columns. This is primarily due to the thin coatings available at this time. Figure 7 shows a chromatogram of (+) methamphetamine on an 86-cm column coated with poly(dimethylsiloxane), also known as "OV-1". This is the same stationary phase used by the chemical supplier for their purity check as discussed in the Background section. The coating in the microcolumn, however, is probably thinner, making separations more difficult. The solvent clearly dominates the chromatogram in Figure 7. A more concentrated solution of the drug would be beneficial to the analysis, but time constraints did not allow this.

The analysis shown in Figure 7 was performed isothermally at 50°C at a slow flow rate (<2 cc/min.).

The analysis of other drugs including LSD, cocaine, and THC were attempted with microGCs coated with OV-1, OV-17, and carbowax. No separations were obtained. The other phases tested should have provided greater retention of the drug molecules, and therefore better separation from the solvent, but the drug molecules could not be detected.

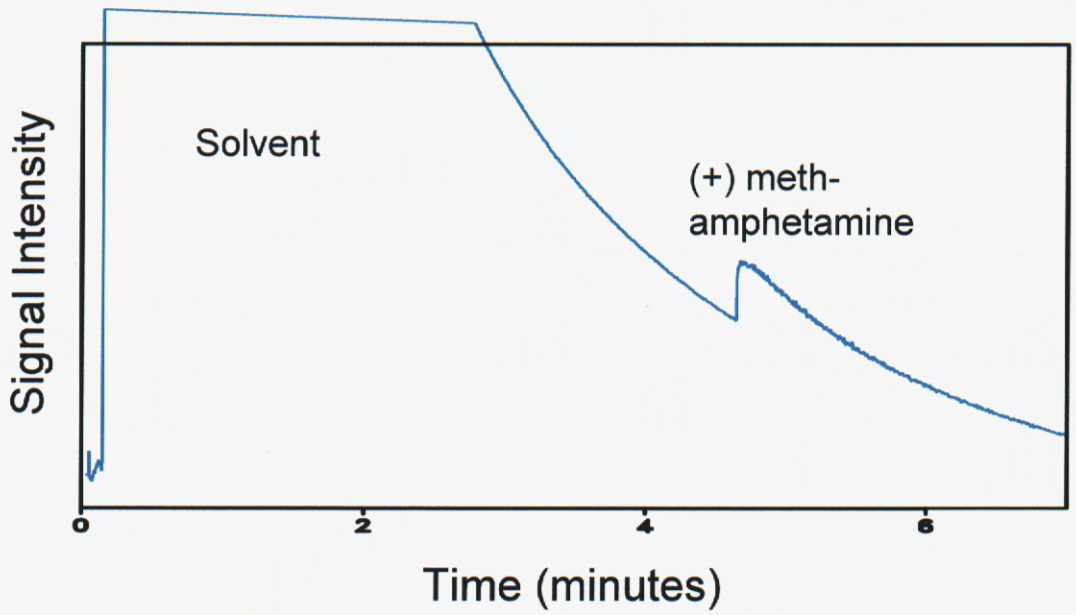

Figure 7. MicroGC analysis of methamphetamine in methanol

MicroGC tests were also performed using SPME fiber introduction and methamphetamine HCl. The analysis of 100 ppm and 1000 ppm sample solutions is shown in Figure 8. The advantage of the SPME fiber is that it reduces the amount of solvent introduced into the microGC column. A reduced solvent load improves the chromatography on these short, thin stationary phase columns. The improvement in the analysis (as compared to Figure 7) can be observed in Figure 8. Other, less-volatile drug analytes would be expected to elute at longer times and many would require higher temperatures as well.

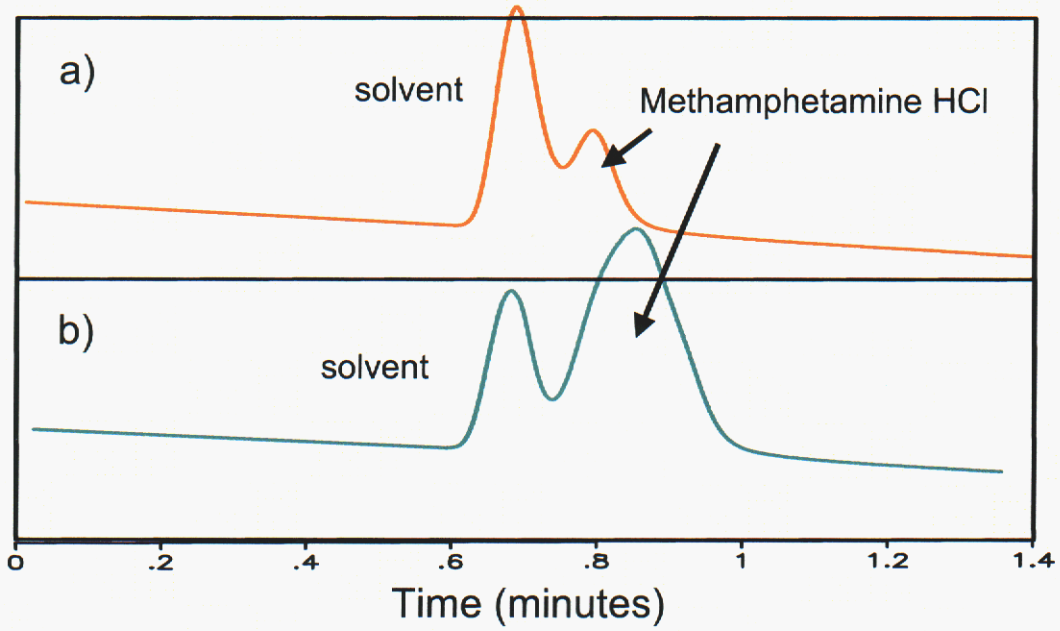

Figure 8. SPME fiber introduction of a) 100 ppm solution of methamphetamine HCl and b) 1000 ppm solution of methamphetamine HCl.

III-4.2 Preconcentrator Tests

Because of time constraints and the limited results on the microGC columns, preconcentrators were not tested. For reference, a scanning electron micrograph (SEM) of a preconcentrator device is shown in Figure 9. These silicon nitride membranes can be coated with any number of polymers (for trapping analytes) and then heated to desorb the analytes rapidly for analysis. The procedure is similar to that for liquids using Solid Phase Microextraction (SPME) fibers, only in the vapor phase.

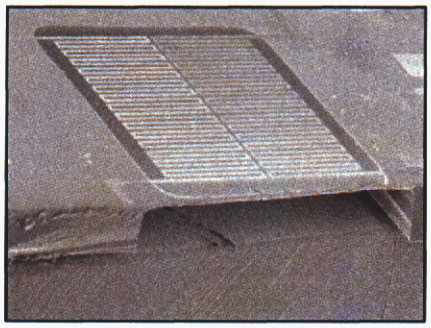

Figure 9. Scanning electron micrograph of preconcentrator structure.

III.V Conclusions

III.V.1 MicroGC tests

This work presented two challenges: to separate the solvent from the drug, and to maintain conditions for elution of the drug. High temperatures are required to keep the drug compounds in the vapor phase, yet higher temperatures cause faster elution. This is a limitation of the (relatively) short microGC columns tested here. These columns are approximately one meter while typically drug analyses are performed using 15-meter and longer columns. Sample introduction using an SPME fiber improved the ability of one microGC to separate the sample solvent and drug analyte, and would be a recommended technique for further evaluation of microGC columns in this application.

There is the potential for separation of drug compounds; however, two enhancements of the microGC columns would enable better performance. These are the ability to temperature ramp and to use thicker stationary phase coatings. The ability to temperature ramp is already available but only for very few microGC columns. This ability would allow greater separation of analyte solvent from the drug analytes. Most microGCs available for testing in the laboratory are contained in aluminum- or silicon-protected fixtures, the thermal mass of which destroys the ability to temperature ramp during analysis. Thicker stationary phases are under development but are not available at this time.

An additional technology that would enable easier separation and analysis of drugs by microGC is derivatization. This is a common technique for reducing the boiling point and polarity of an analyte that enables separation at lower temperatures. The drawback is that derivatization adds another step to the analyses and complicates the implementation of a portable system. Derivatization/vaporization techniques have already been demonstrated using devices similar to the preconcentrator described in this document, and its application to drug analytes could be the subject of future investigation.

III.V.2 Preconcentrator Tests

Preconcentrators were not tested. It should be noted, however, that coatings used in commercial procedures for collection and preconcentration of drugs from liquids can also be coated on the microfabricated preconcentrators available at Sandia. The major limitation will be the limited availability of these drug molecules in the vapor phase.

IV. Collection of Trace Narcotics Material Using a Miniaturized Version of the Sandia Screen Preconcentrator (SSP)

Work performed on this project in department 5848 focused on the use of our patented preconcentrator, the Sandia screen preconcentrator (SSP), to collect narcotics vapor. It is envisioned that a miniaturized real-world system for narcotics detection might employ a miniaturized SSP as the first collection stage for trace material, after which the material would be delivered to a micro-preconcentrator and micro-chemical sensor developed in Center 1700. A limited amount of work involving the collection of narcotics vapor has been done previously with a larger (six-inch diameter) version of the SSP. The results of that study [5] showed an average preconcentrator collection efficiency of 57% for methamphetamine vapor and 56% for

cocaine vapor. An effort was made to repeat similar studies with a miniaturized SSP having a screen diameter of approximately 1.5 inches (see Figure 10.)

In these studies, the miniaturized SSP was interfaced to an Ion Track Instruments (ITI) VaporTracer, a hand-held explosives detection system that is based on ion mobility spectrometry (IMS). The ITI VaporTracer normally accommodates an inlet airflow of approximately 1 to 2 liters per minute, while the miniaturized SSP can accommodate an inlet flow on the order of 100 liters per minute. Thus, the SSP adds value to this system by increasing the air-sampling rate by close to two orders of magnitude. To evaluate the efficiency of the SSP in collecting narcotics vapor, two numbers need to be compared:

(1) The signal from the VaporTracer when a known amount of narcotic material is placed directly onto the screen of the SSP. This is accomplished by using a syringe to deposit a drop of solution that contains a known concentration of the narcotic, allowing the solvent to evaporate, and then heating the preconcentrator screen to desorb the material into the VaporTracer.

(2) The signal from the VaporTracer when the same amount of narcotic is desorbed as a gas into the inlet flow of the SSP, and subsequently desorbed into the VaporTracer. This is accomplished by again using the syringe to place an identical solution drop onto a hotwire flash desorber, allowing the solvent to evaporate, and then heating the hotwire to desorb the narcotic material into the SSP inlet. After collection, the material is desorbed into the VaporTracer as before.

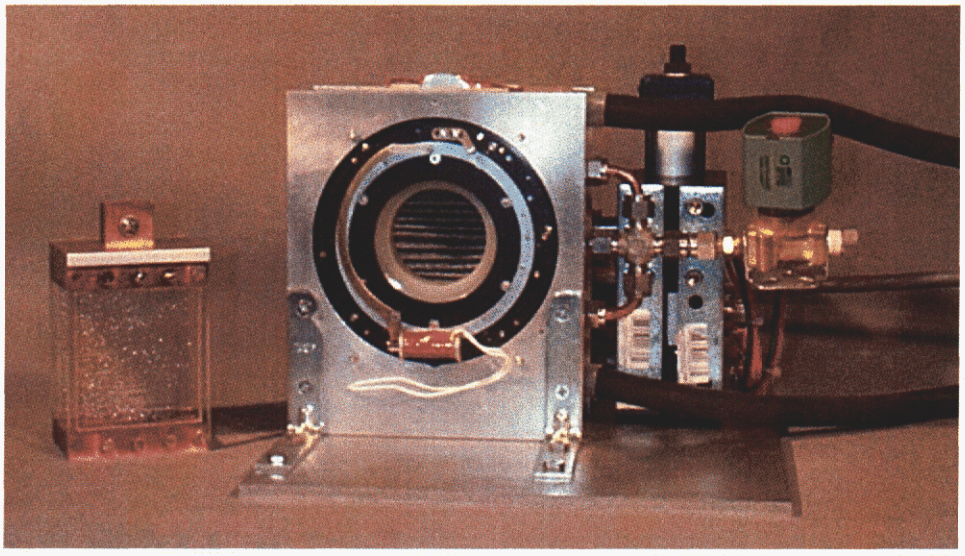

Figure 10. Miniaturized Preconcentrator

The ratio (2)/(1) will yield the approximate collection efficiency of the SSP for the narcotic vapor involved, provided that there are not extraneous experimental errors such as decomposition of a large portion of the narcotic material on the tip of the flash desorber.

A series of experiments of this type were performed with methamphetamine and cocaine. For each drug, 10 nanogram samples were deposited onto either the miniaturized SSP screen or the flash desorber, and each type of experiment was performed four times for each drug, in order to attempt to obtain good average values. In the case of methamphetamine, an average collection efficiency of 45% was obtained, in reasonable agreement with earlier results involving the larger SSP. In the case of cocaine, the average collection efficiency obtained was only 18%, suggesting either significantly reduced efficiency compared to the larger SSP, or (perhaps more likely), a problem with decomposition of the cocaine on the flash desorber tip under the experimental conditions used. These preliminary results suggest that the miniaturized SSP could be used to collect vapor of key narcotics, possibly with some loss of efficiency compared to larger versions of the same preconcentrator.

V. Summary

The principal results of this study can be summarized as follows:

(1) The extraction of cocaine, heroin, and THC from seawater has been demonstrated, using an SPME filter and with separation and detection employing a traditional gas chromatograph/mass spectrometer system. While little time was available to pursue the optimization of this technology, either through utilization of the most applicable GC coating or selection of the best set of operating conditions, the results obtained are promising enough to indicate that future work in this area is likely to be fruitful.

(2) The detection of trace narcotics using microsensors has been limited to using a micro-gas chromatograph coupled with a flame ionization detector to separate methamphetamine from a solvent. Though again little time was available for optimization, the results obtained give reasons to believe that future investigations could be beneficial. In the brief studies performed, drugs other than methamphetamine were not successfully separated from a solvent, perhaps due to the relative shortness of the GC column, and the thinness of the coating.

(3) It has been shown that a miniaturized (1.5 inch diameter) Sandia screen preconcentrator (SSP) can effectively collect methamphetamine vapor, with a collection efficiency close to 50%, i.e., little different from that obtained with a six-inch SSP. Preliminary results for the collection of cocaine vapor indicate an efficiency near 20%, though with very little optimization. These results suggest that a miniaturized SSP might serve as a useful front-end collection device for a detection system based on one of Sandia's microsensors.

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[5] *Trace Detection of Narcotics Using a Preconcentrator/Ion Mobility Spectrometer System*, J. E. Parmeter, G. A. Eiceman, and J. E. Rodriguez, National Institute of Justice Report 602-00, National Institute of Justice Office of Science and Technology, Washington DC, April 2001.

Appendix A. Additional Information on the Drug Problem and Drug Detection Technologies

Drug Detection Technology Reports

Report Title	Source	Authors
Guide for the Selection of Drug Detectors for Law Enforcement Applications	National Institute of Justice, NIJ Guide 601-00	John E. Parmeter, Dale W. Murray, David W. Hannum
Use of Ion Mobility Spectrometry in the Detection of Traces of Controlled Substances	Gazette, Volume: 59 Issue: September 1997, Pages: 20 to 22	D. Paradis
Terrorism and Drug Trafficking: Technologies for Detecting Explosives and Narcotics	airportnet http://www.airportnet.org/DEPTS/federal/gao/terror.htm Letter Report, 09/04/96, GAO/NSIAD/RCED-96-252	GAO Report
Terrorism and Drug Trafficking: Testing Status and Views on Operational Viability of Pulsed Fast Neutron Analysis	Letter Report, 04/13/99, GAO/GGD-99-54 http:www.securitymanagement.com/library/ggd9954.txt	GAO Report
Development of Polarization Free CdZnTe Detector Arrays for Ultra-Fast Hyperspectral X-Ray Imaging	DOD SBIR Report http://www.dodsbir.net/awardlist/abs002/dodabs002.htm	NOVA R&D, INC. 1525 Third St., Suite C Riverside, CA 92507
Synthesis and Functionalization of Quantum Dots for Bio Agent Detection	DOD SBIR Report http://www.dodsbir.net/awardlist/abs002/dodabs002.htm	BIOCRYSTAL, LTD. 575 McCorkle Boulevard Westerville, OH 43082 Contact: Dr. Emilio Barbers-Guillem, (614) 818-110
"Scanning of Prison Visitors Under Fire; Inaccurate Drug Detector Prompts Unfair Penalties"	Pittsburgh Post-Gazette (08/27/01) P. B5 www.post-gazette.com	Bucsko, Mike

Needs & Requirements for Drug Detection

Agency	Source	Needs/Requirements	Contact
DOT	SBIR	A compact, accelerator-based neutron source for baggage interrogation	Accsys Technology Inc 1177 A Quarry Ln Pleasanton, CA 94566 Contact: Dr. Robert W. Hamm, President
DOT	SBIR	An innovative, portable, and non-destructive cocaine/heroin drug detector	Nova Electronics & Software 3564 Central Avenue; Suite 2g Riverside, CA 92506

Needs & Requirements for Drug Detection

Agency	Source	Needs/Requirements	Contact
White House, U.S. Customs Service, U.S. Coast Guard, DoD, CAC	2001 Counterdrug Research & Development Blueprint Update Appendix D	• Fixed Site Truck X-ray • Mobile Truck X-ray • Gamma Ray Imager • Railroad Car Gamma Ray Imager • Marine Container X-ray System • Small Pallet X-ray System • Gamma Ray Imager – Pallet • Large Pallet X-ray System • Body Imaging Systems • Pulsed Fast Neutron Analysis	See Report http://www.whitehouse drugpolicy.gov/publications/ scimed/blueprint01/ appendixd.html
White House, U.S. Customs Service, US Coast Guard, DoD, CTAC	2001 Counterdrug Research & Development Blueprint Update Appendix B	**Short Term (1-2 years)** • Improved x-ray & gamma ray detector technology • Accurate signatures for detectable illicit drug emissions • Computer-assisted drug recognition for imaging systems • Portable vapor and space detection • Portable/Transportable capability to detect & classify drugs • Portal Detection Systems for screening passengers • Standards for technologies that detect drugs on people • Cost-effective way to detect small amounts of drugs in large volumes • SAW-Immunoassay narcotics detection • Hand-held bulk currency detector **Medium Term (3-5 years)** • Rapid & safe detection of drugs in vehicles • Rapid & safe detection of drugs in moving vehicles • Rapidly detect drugs hidden on underside of vehicles • Multi-purpose portal to detect soft & hard contraband **Long Term (over 5 years)** • Improvements in nonintrusive tools for drug detection • Improved large container inspection systems	See Report http://www.whitehouse drugpolicy.gov/publications/ scimed/blueprint01/ appendixb.html

Drug Detection Technology

Company	Product	Web Site	Technology	Comments
American Bio Medica Corp.*	Drug Detector	americanbiomedica.com	wipe/spray	Works on hand/finger prints
Bio Sensors Applications Sweden AB*	Narkotikdetektion	biosensor.se/se-tekprod_narkotika.html	Not known	Web site in Swedish
Scintrex*	NDS-2000 Hand Held Narcotics Detector	isdetectors.com/products/scintrex nds2000.html	Swipe	Can be used on fabric
Barringer	IONSCAN 400B	barringer.com	Swipe	
Instrument Technology, Inc.*	Master Drug/Contraband Detection Kit	epgcta.com/masterdrug.htrr	Various	
Barringer	Sabre 2000	barringer.com	vapor/particle	Handheld
Electronic Sensor Technology	4100 Gas Chromatograph, Electronic Nose	estcal.com		
Intelligent Detection Systems (IDS)	NDS-2000 Hand Held Narcotics Detector	idsdetection.com	GC/IMS	
Ion Track Instruments (ITI)	Itemiser	iontrack.com/itemiser.html	IMS	
Ion Track Instruments (ITI)	VaporTracer	iontrack.com/vaportracer.html	IMS	Handheld
Becton Dickenson Public Safety*	NIK Substance ID Swabs		Swipe	Used on surfaces
SAIC	CDS-2002i Contraband Detector	saic.com/products/security/contraband-detector/cds.htm	radioactive source	Measures backscatter through solid surfaces
Bio Sensors Applications Sweden AB	Biosensor	biosensor.se		

* Not shown in NIJ Guide 601-00

Technology

Technology	Minimum Detection Limit	Configuration	Typical Cost
Trace Detection	1-10 Micrograms	Kit of Aerosol Spray Cans	$500.00/Kit
Trace Detection	Subnanogram	Handheld IMS	$25,000.00
Trace Detection	Subnanogram	Portable IMS	$45,000.00
Bulk Detection	2-10 grams	Half-Ton Mobile Cart (X-Ray)	$65,000.00
Bulk Detection	2-10 grams	3-ton enclosure (CT Scan)	$650,000.00

from "July 2001 Corrections Today"

See NIJ Guide 601-00 for more details on room temperature vapor pressure of drugs.

Possible New Technologies

New Technology	Reference
Bacterial Enzyme Detects Cocain	Applied and Environmental Microbiology, March 2000
PL-ELS 1000 Evaporative Light Scattering Detector	polymerlabs.com
Ion Microprobe	inel.gov/featurestories/1998-2000/ 4-99secure.shtm
Non-Invasive Glucose/Drug/Alcohol Detection	Rio Grande Medical Technology Albuquerque, NM
Non-Invasive Glucose Detection	GlucoWatch Cygnus www.cygn.com
Non-Invasive Alcohol Detection	Alcohol Monitoring System, LTD "Secure Continuous Remote Alcohol Monitor (SCRAM) Kirby Phillips (303) 989-8900

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